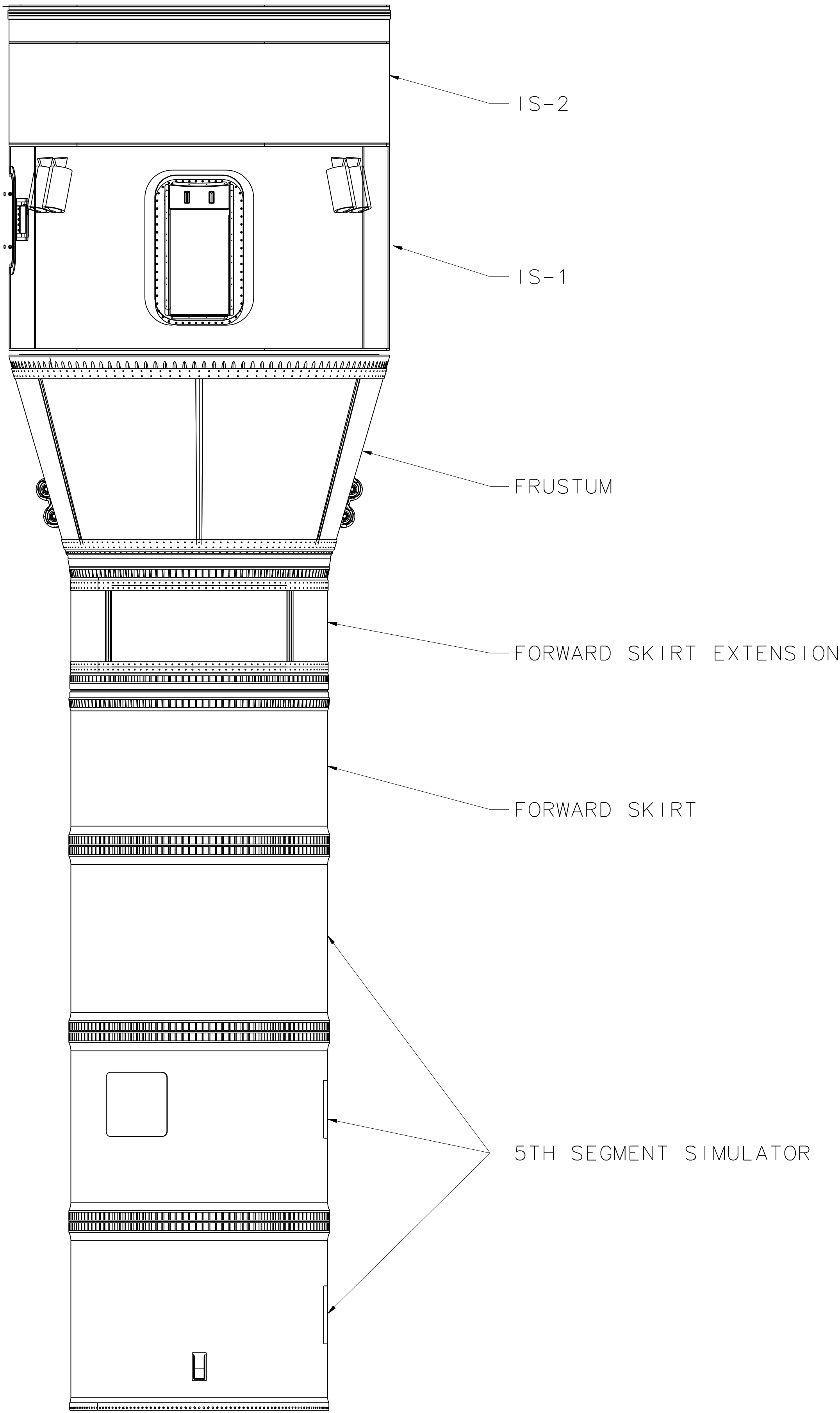


ARES 1-X



STACK 1

ARES 1-X PROPERTIES SOURCES:  
MASS, CG, AND LENGTH DIMENSIONS FROM:  
ATK DOCUMENT NO: TR018580,  
"ARES 1-X FIRST STAGE MASS PROPERTIES REPORT"  
FROM JULY 03, 2007;  
COMPONENT DIAMETER DIMENSIONS FROM:  
ARES 1-X MEL FOR PRO-E 060213\_ARES\_UPPER\_STAGE.ASM  
(BASELINED 08/28/2007).

TR018580, TABLE 3 (PARTIAL)				
SUBASSEMBLIES	MASS(LBM)	LENGTH(IN)	Y,CG(IN)	Z,CG(IN)
USS INTERSTAGE (IS1 AND IS2)	57,320.6	185.5	0.0	-1.3
FRUSTRUM	13,341.4	122.1	-0.3	0.0
FORWARD SKIRT EXTENSION	21,440.2	72.9	-0.2	0.0
FORWARD SKIRT	11,085.1	84.0	-0.4	0.0
5TH SEGMENT SIMULATOR	45,774.5	319.9	0.0	0.0
TOTAL	148,961.8	784.4	-0.1	-0.5

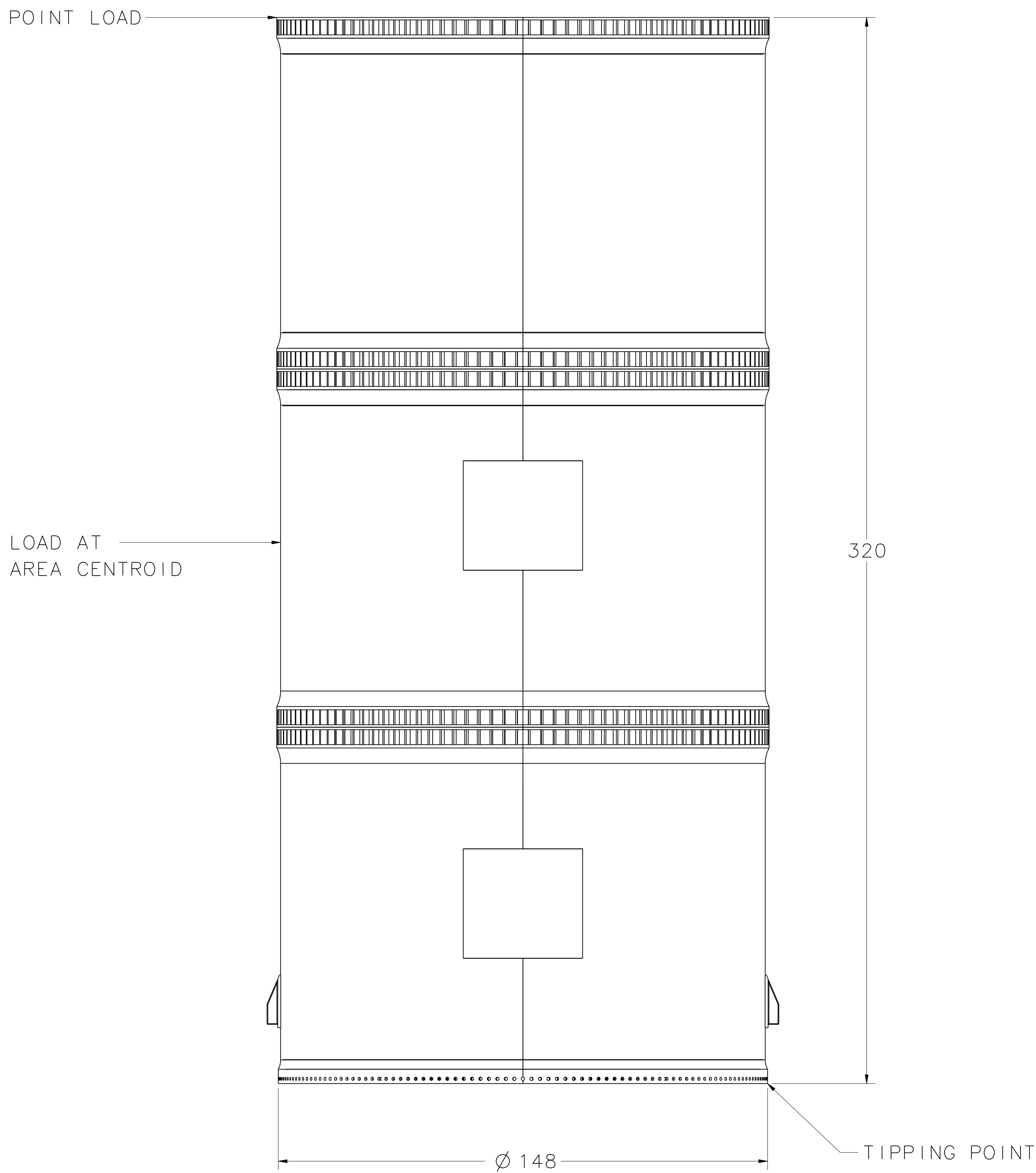
NOTE: CG TOTALS CALCULATED FROM COMPONENT DATA

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED ONLY BY THE DESIGN ACTIVITY				UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994. TOLERANCES ON: FRACTIONS DECIMAL ANGLES ±1/16 .X± .XX± ±° .XXX±		ORIGINAL DATE OF DRAWING (YY/MM/DD) 2009/02/03 DRAFTER CHECKER M L LIND ENGINEER CHECKER ENGINEER STRESS ENGINEER K SHOWALTER		JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA					
SOFTWARE NX 5/TEAMCENTER	FILENAME 037429	MATERIAL	HEAT TREATMENT	FINAL PROTECTIVE FINISH	NEXT ASSY USED ON	NEXT ASSY USED ON	THIRD ANGLE PROJECTION	APPROVED A EKHLASS1 USA 91244	SUBMITTED R PATTISON		ARES 1-X STACK 1 STABILITY STUDY		
					APPLICATION		SCALE NOTED		SIZE F	CAGE CODE 22264	DWG NO. 95K01202	REV	
									UNIT WEIGHT		SHEET 1 OF 4		

ARES I-X STACKING STUDY

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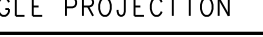
5TH SEGMENT SIMULATOR ASSEMBLY



### STABILITY ANALYSIS:

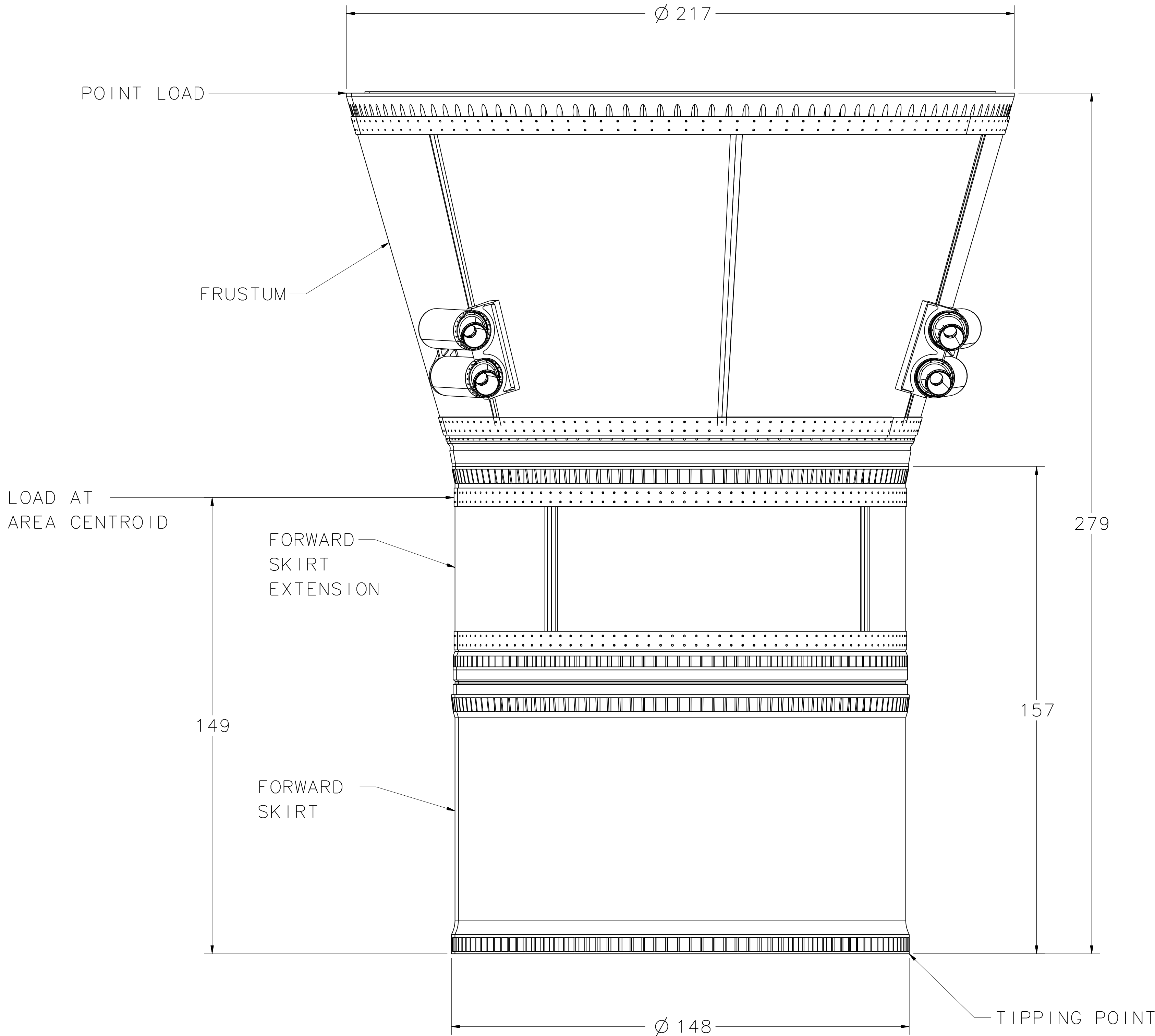
1. PER TRO18580, TABLE 3:  
MASS = 45,775 LB  
Y,CG = 0.0 IN  
Z,CG = 0.0 IN
2. IF STACK IS PLACED UNSECURED ON A LEVEL SURFACE, THE TIPPING POINT IS CLOSE TO THE EDGE, THE MAXIMUM FORCES THAT CAN BE APPLIED ARE SHOWN IN THE TABLE BELOW.
3. EXTERNAL TANK CHECK-OUT CELLS DESIGN CRITERIA FROM THE DRAWING 79K09165 "VAB HIGH BAY 2 SHUTTLE MODIFICATIONS" SPECIFY A WIND LOAD OF "7.5 P.S.F. ON THE AREA PROJECTED ON A VERTICAL SURFACE OF THE TANK ONLY".  
NOTE: 7.5 P.S.F. EQUATES TO AN APPROXIMATE WIND SPEED OF 59 MPH USING ASCE CRITEREA.
4. THE DOCUMENT ASCE 7-98 "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES" INCLUDES WIND LOAD CALCULATIONS IN SECTION 6. WITH A 5 TO 1 SAFETY FACTOR, TIPPING OCCURES AT APPROXIMATELY 78 MPH.
5. THE COEFFICIENT OF FRICTION OF 0.8 FOR A STEEL TO STEEL CONTACT IS GIVEN IN THE MACHINERY'S HANDBOOK 27, PAGE 158. OTHER SOURCES USE 0.74.  
A CONSERVATIVE COEFFICIENT OF 0.7 IS USED IN CALCULATIONS.

DATA SUMMARY		
FORCE REQUIRED TO CAUSE OVERTURNING		
POINT LOAD AT TOP	10,585	LB.
LOAD FOCUSED AT AREA CENTROID	21,171	LB.
PER VAB HIGH BAY 2 DESIGN CRITERIA		
PROJECTED AREA	329	SQ. FT.
WIND LOAD (7.5 PSF, FROM 79K09165 S-1)	2,466	LB.
SAFETY FACTOR ON OVERTURNING	8.6	
PER ASCE 7-98 OUTDOOR DESIGN CRITERIA (REFERENCE ONLY)		
DESIGN WIND LOAD (130 MPH)	36	P.S.F.
DESIGN WIND FORCE (130 MPH)	11,844	LB.
SAFETY FACTOR ON OVERTURNING	1.8	
FRICTION		
NORMAL FORCE (STACK MASS)	45,775	LB.
COEFFICIENT OF FRICTION (STEEL-STEEL)	0.7	
MAX. FORCE OF FRICTION	32,043	LB.

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED ONLY BY THE DESIGN ACTIVITY				UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994. TOLERANCES ON:		ORIGINAL DATE OF DRAWING (YY/MM/DD) 2009-02/03		JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA									
SOFTWARE NX 5/TEAMCENTER				FRACTIONS DECIMAL ANGLES		DRAFTER ENGINEER ENGINEER ENGINEER		CHECKER M LIND CHECKER STRESS K SHOWALTER		ARES 1-X STACK 1 STABILITY STUDY							
FILENAME 037429																	
MATERIAL		NEXT ASSY		USED ON													
HEAT TREATMENT		NEXT ASSY		USED ON		THIRD ANGLE PROJECTION		SUBMITTED R PATTISON		SIZE F		CAGE CODE 22264		DWG NO. 95K01202		REV	
FINAL PROTECTIVE FINISH		APPLICATION						APPROVED A EKHLESI USA 91244		SCALE NOTED		UNIT WEIGHT		SHEET 2		OF	

ARES I-X STACKING STUDY

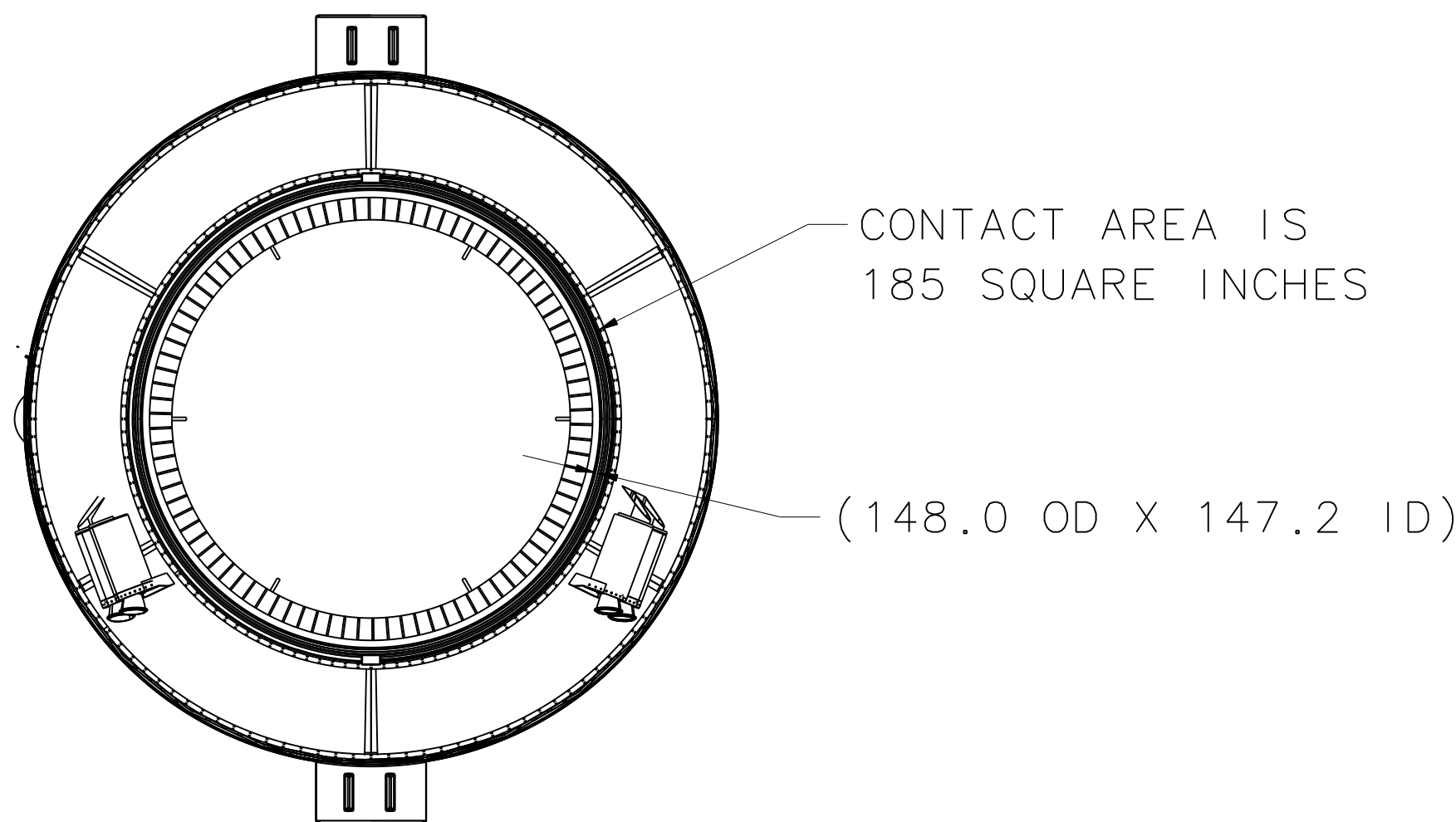
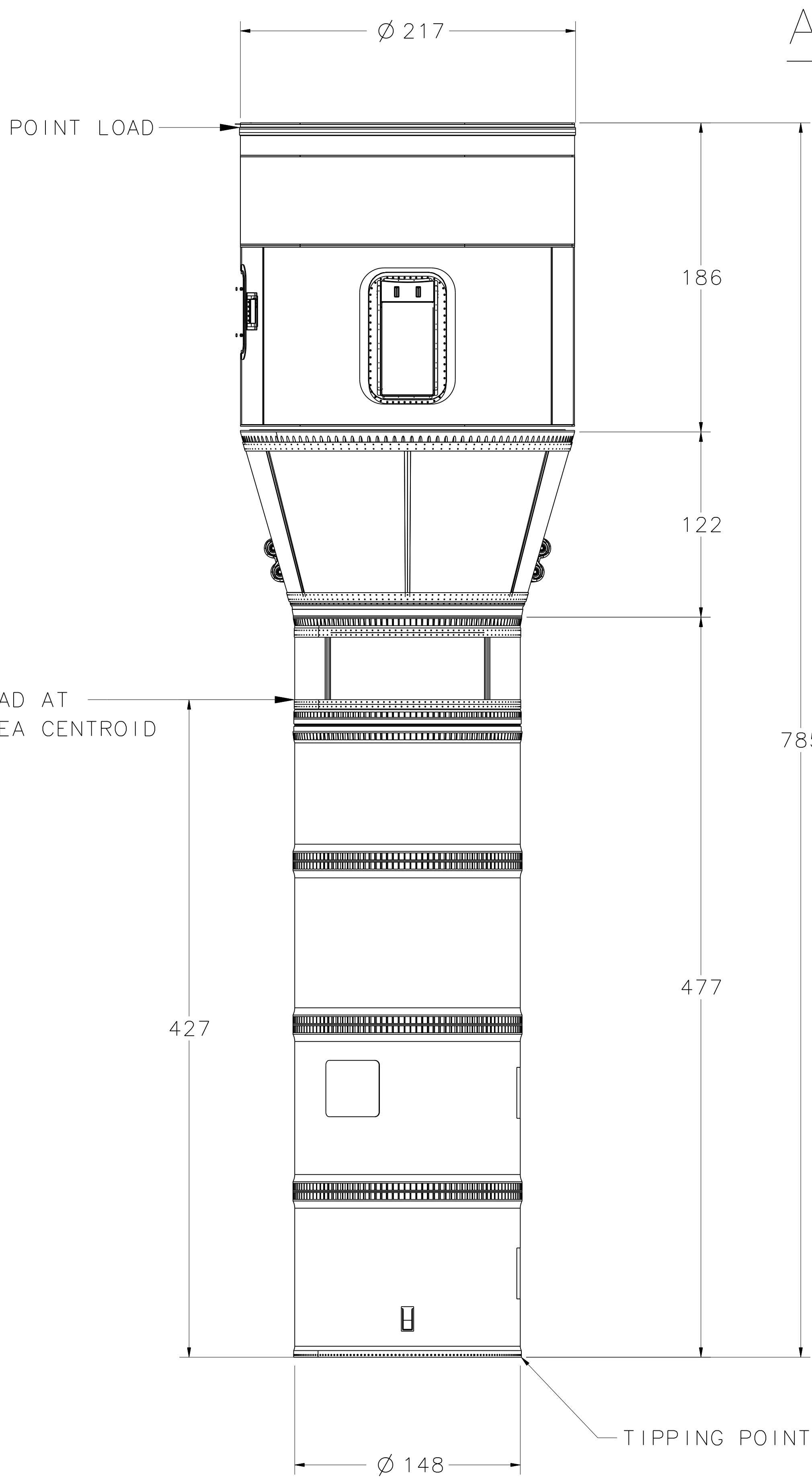
FRUSTUM/SKIRT ASSEMBLY



STABILITY ANALYSIS:

- PER TR018580, TABLE 3:  
MASS = 45,866 LB  
Y,CG = -0.3 IN  
Z,CG = 0.0 IN
- SMALL CG OFFSET FROM CENTER NEGLECTED IN CALCULATIONS.
- IF STACK IS PLACED UNSECURED ON A LEVEL SURFACE, THE TIPPING POINT IS CLOSE TO THE EDGE, THE MAXIMUM FORCES THAT CAN BE APPLIED ARE SHOWN IN THE TABLE BELOW.
- EXTERNAL TANK CHECK-OUT CELLS DESIGN CRITERIA FROM THE DRAWING 79K09165 "VAB HIGH BAY 2 SHUTTLE MODIFICATIONS" SPECIFY A WIND LOAD OF "7.5 P.S.F. ON THE AREA PROJECTED ON A VERTICAL SURFACE OF THE TANK ONLY".  
NOTE: 7.5 P.S.F. EQUATES TO AN APPROXIMATE WIND SPEED OF 59 MPH USING ASCE CRITEREA.
- THE DOCUMENT ASCE 7-98 "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES" INCLUDES WIND LOAD CALCULATIONS IN SECTION 6. WITH A 5 TO 1 SAFETY FACTOR, TIPPING OCCURES AT APPROXIMATELY 82 MPH.
- THE COEFFICIENT OF FRICTION OF 0.8 FOR A STEEL TO STEEL CONTACT IS GIVEN IN THE MACHINERY'S HANDBOOK 27, PAGE 158. OTHER SOURCES USE 0.74.  
A CONSERVATIVE COEFFICIENT OF 0.7 IS USED IN CALCULATIONS.

DATA SUMMARY		
FORCE REQUIRED TO CAUSE OVERTURNING		
POINT LOAD AT TOP	12,165	LB.
LOAD FOCUSED AT AREA CENTROID	22,779	LB.
PER VAB HIGH BAY 2 DESIGN CRITERIA		
PROJECTED AREA	315	SQ. FT.
WIND LOAD (7.5 PSF, FROM 79K09165 S-1)	2,363	LB.
SAFETY FACTOR ON OVERTURNING	9.6	
PER ASCE 7-98 OUTDOOR DESIGN CRITERIA (REFERENCE ONLY)		
DESIGN WIND LOAD (130 MPH)	36	P.S.F.
DESIGN WIND FORCE (130 MPH)	11,340	LB.
SAFETY FACTOR ON OVERTURNING	2.0	
FRICTION		
NORMAL FORCE (STACK MASS)	45,866	LB.
COEFFICIENT OF FRICTION (STEEL-STEEL)	0.7	
MAX. FORCE OF FRICTION	32,106	LB.



# ARES I-X STACKING STUDY

## STACK 1

### STABILITY ANALYSIS:

- PER TRO18580, TABLE 3:  
MASS = 148,961 LB  
Y,CG = -0.1 IN  
Z,CG = -0.5 IN
- SMALL CG OFFSET FROM CENTER NEGLECTED IN CALCULATIONS.
- IF STACK IS PLACED UNSECURED ON A LEVEL SURFACE, THE TIPPING POINT IS CLOSE TO THE EDGE, THE MAXIMUM FORCES THAT CAN BE APPLIED ARE SHOWN IN THE TABLE BELOW.
- EXTERNAL TANK CHECK-OUT CELLS DESIGN CRITERIA FROM THE DRAWING 79K09165 "VAB HIGH BAY 2 SHUTTLE MODIFICATIONS" SPECIFY A WIND LOAD OF "7.5 P.S.F. ON THE AREA PROJECTED ON A VERTICAL SURFACE OF THE TANK ONLY".  
NOTE: 7.5 P.S.F. EQUATES TO AN APPROXIMATE WIND SPEED OF 59 MPH USING ASCE CRITEREA.
- THE DOCUMENT ASCE 7-98 "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES" INCLUDES WIND LOAD CALCULATIONS IN SECTION 6. WITH A 5 TO 1 SAFETY FACTOR, TIPPING OCCURES AT APPROXIMATELY 51 MPH.
- FLOOR CONTACT AREA IS 185 SQUARE INCHES.  
FLOOR UNIFORM CONTACT PRESSURE IS 805 PSI.  
FLOOR CONTACT PRESSURE IS 3000 PSI WHEN CONTACT AREA IS REDUCED TO 27%.
- THE COEFFICIENT OF FRICTION OF 0.8 FOR A STEEL TO STEEL CONTACT IS GIVEN IN THE MACHINERY'S HANDBOOK 27, PAGE 158. OTHER SOURCES USE 0.74.  
A CONSERVATIVE COEFFICIENT OF 0.7 IS USED IN CALCULATIONS.

DATA SUMMARY		
FORCE REQUIRED TO CAUSE OVERTURNING		
POINT LOAD AT TOP	14,042	LB.
LOAD FOCUSED AT AREA CENTROID	25,815	LB.
PER VAB HIGH BAY 2 DESIGN CRITERIA		
PROJECTED AREA	925	SQ. FT.
WIND LOAD (7.5 PSF, FROM 79K09165 S-1)	6,938	LB.
SAFETY FACTOR ON OVERTURNING	3.7	
PER ASCE 7-98 OUTDOOR DESIGN CRITERIA (REFERENCE ONLY)		
DESIGN WIND LOAD (130 MPH)	36	P.S.F.
DESIGN WIND FORCE (130 MPH)	33,300	LB.
SAFETY FACTOR ON OVERTURNING	0.8	
FRICTION		
NORMAL FORCE (STACK MASS)	148,961	LB.
COEFFICIENT OF FRICTION (STEEL-STEEL)	0.7	
MAX. FORCE OF FRICTION	104,273	LB.

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED ONLY BY THE DESIGN ACTIVITY			UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES PER ASME Y14.5M-1994: FRACTIONS DECIMAL ANGLES	ORIGINAL DATE OF DRAWING (YY/MM/DD) 2009/02/03	JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA		
SOFTWARE NX 5/TEAMCENTER				DRAFTER ENGINEER ENGINEER ENGINEER	M. LIND CHECKER CHECKER STRESS K. SHOWALTER		
FILENAME 037429							
MATERIAL	NEXT ASSY	USED ON	THIRD ANGLE PROJECTION	SUBMITTED			
HEAT TREATMENT	NEXT ASSY	USED ON		R. PATTISON			
FINAL PROTECTIVE FINISH	APPLICATION			APPROVED A. EKHLASSI USA 91244			
					SIZE F		
					CAGE CODE 22264		
					DWG NO. 95K01202		
					SCALE NOTED		
					UNIT WEIGHT		
					SHEET 4 OF 4		